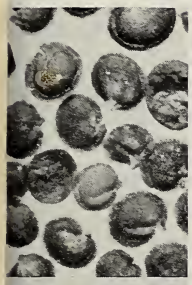
AGRICULTURAL Research

January 1963/U.S. Department of Agriculture



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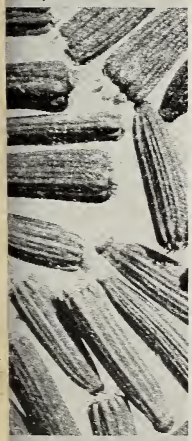

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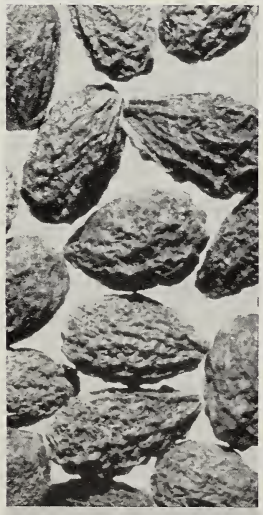

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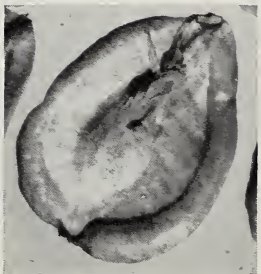

Cape Marigold

Crambe

AGRICULTURAL
Research

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Paying Its Way

ARS utilization research and development—to gain new markets for farm commodities—has a special urgency today.

Not only are American farmers producing an overabundance of some commodities, but increasingly industrial research is creating products that compete for traditional farm markets.

The American flax producer, for example, lost a third of his linseed oil market during the 1950's. The reason: water-soluble, latex paints—a product of industrial research—became more popular than linseed oil paints.

To meet this kind of competition, utilization scientists are working on about 400 projects, half of which are concerned with industrial applications and half with food and feed uses. They deal with the raw materials of agriculture—cereals, forage crops, fibers, fruits and vegetables, oilseeds, livestock and livestock products, and new and special plants.

In 1962, alone, 84 public service patents were issued on ARS utilization research. One patent is a competitive answer to water-soluble, latex paints. Now on the market is a linseed oil paint that rinses from a brush with water, that dries to the touch in about 15 minutes, and that resists blistering.

Beyond regaining lost markets, utilization scientists are looking ahead to expanding markets with new crops from previously uncultivated plants. A handful of foreign plants—screened from 3,400 samples—have yielded promising new oils for industry. (See page 8 in this issue.)

Success of this seed-oil work—in terms of increased incomes to farmers—belongs to the future. But the story of soap shows that utilization research is already paying its way.

A few years back the much heralded detergents washed away more than half of the soap market once dominated by animal fats. Large surpluses were building up, and the farm profit squeeze was tightening.

Today, this market void has been filled through utilization research. More than 600 million pounds of animal fats are used each year as feed additives alone, not to mention more than 50 million pounds now used in plastics, lubricants, and lubricant additives.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

A genetic find
brightens the outlook for . . .

Hybrid Wheat

Flowers on this male-sterile wheat remain open until pollinated; those on normal wheat open for only a short time.

■ Plant breeders have been inspired for decades with the hope that they could produce hybrid wheat varieties.

Success in this effort may be just over the horizon.

Scientists of ARS and the Nebraska Agricultural Experiment Station have found genetic material that restores fertility in male-sterile breeding lines.

This genetic material, which the scientists call restorer genes, is the second of two breeding tools that have been needed to start development of commercial hybrid wheat varieties. The other tool—cytoplasmic male sterility—has been known to exist in various forms for some time.

Now that breeders can control both male sterility and male fertility, they can eliminate the time-consuming job of crossing wheat lines by hand pollination. This has been the bottleneck in producing hybrid seed in a perfect-flowered plant like wheat in which the flower contains both male and female parts.

In male-sterile plants the pollen-bearing parts are either so aborted or maldeveloped that they do not function. This condition is heritable. Because male-sterile plants do not produce pollen, they do not set seed unless pollen is introduced from another source.

Restorer gene aids large-scale crossing

Male-sterile plants produce seed if a suitable pollinating plant is close enough to shed pollen on the female parts of the flower—at the time the male-sterile plants are in bloom. With such breeding material, it is possible to build up large amounts of seed of a male-sterile strain. Eventually, a line can be developed that is suitable for crossing with another carefully developed line to produce hybrid seed.

However, if the pollen used in the final cross does not carry a male-fertility-restoring factor, the hybrid seed is worthless for planting in a farmer's field for grain production. The seed will germinate and produce plants with typical hybrid vigor, but the plants lacking the restoring factor will all be male-sterile and will not shed pollen.

Therefore, in making the final cross—the one that results in commercial hybrid seed for grain production—the plant breeder must use pollen containing male fertility restorer genes.

The ARS-Nebraska team found the restorer gene (or genes) in an ex-

Turn page

Hybrid Wheat

(Continued)

perimental bread wheat strain selected from a cross made in Nebraska in 1941. According to the Nebraska records, a numbered strain identified as a *Triticum timopheevi* x *Triticum vulgare* derivative was crossed with Nebred, one of Nebraska's important commercial varieties. Two selections from this cross were saved and since 1953 have been propagated in a Nebraska wheat germ plasm nursery. They were presumed to be normal self-fertile strains until last spring, when close observations revealed male-sterile plants in one of the strains.

Cross overcomes male sterility

Crosses of the experimental male-sterile plants with Bison, another commercial variety, produced first-generation plants that failed to shed pollen at heading late last summer. In contrast, the first-generation plants from male-sterile plants crossed with male-fertile plants of the same line shed pollen normally.

This pollen production indicates that there is a gene (or genes) in the Nebraska experimental strain that overcomes the block to normal pollen development in the male-sterile plants. This block is believed to depend upon the interaction of factors in the cytoplasm with genes of the cell nucleus.

Cytoplasmic male sterility in wheat was first found several years ago by Japanese scientists. They transferred this male sterility from *Aegilops ovata* into durum and common wheats. It was later transferred to several U.S. common wheats by J. A. Wilson, formerly of the Kansas Agricultural Experiment Station, and W. M. Ross, ARS geneticist at the Fort Hays Branch of the Kansas Station. Genes giving complete fertility restoration in common wheat still have not been found for the Japanese-discovered source of sterility.

The Kansas scientists also found a strain of wheat derived from *T. timopheevi* that was cytoplasmically male-sterile. They successfully transferred the sterility through a series of crosses involving the bread wheat Bison as the pollen parent. During 1961, Wilson and Ross attempted to find the restorer in crosses involving timopheevi and Bison. Several of the plants among their experimental crosses actually shed some pollen, but the scientists felt the evidence was not firm that the restorer had been found.

J. W. Schmidt, Nebraska Agricultural Experiment Station agronomist, V. A. Johnson, ARS research agronomist, and S. S. Maan, agronomy instructor at the University of Nebraska, closed the gap this year when they found an effective fertility restorer in their breeding material.

Hybrid wheat outlook is good

The outlook for hybrid wheat for grain production on U.S. farms looks promising. However, much more research will be needed before hybrids with the good qualities in our present commercial types will be available.

Hybrid wheat would provide greater flexibility in attacking problems in wheat production, the scientists say. Once a wide array of male-sterile, fertility-restorer combinations is available, a hybrid tailored to fit emergency situations could be developed much more quickly than a conventional pure line. This would allow, for example, a quick development of new hybrids to combat threatening new rust races and, perhaps, insects such as hessian flies.

Scientists feel that the success of hybrid wheat depends primarily upon how efficiently the seed can be produced and to what extent it would increase yields.☆

lower of a first-generation, male-sterile cross male-sterile wheat x Bison) has restricted an- her development. Infertile pollen, in inset, as no starch.

Fertility has been restored in this cross (male-sterile x the fertility-restoring strain). Anthers are swollen and filled with pollen. Inset shows normal, starch-filled fertile pollen.

PREDICTING DUST STORMS

Index proves 85 percent accurate in anticipating dust storm conditions

■ "Will this be a year when special precautions are needed to prevent soil blowing?"

Many Great Plains farmers ask themselves this question as they make plans for the next crop season, and, until recently, they have had little but guesswork as a basis for their decision.

Using a new wind-erosion climatic index, scientists can predict dust storm conditions on the Great Plains with about 85 percent accuracy. And they can make the prediction 7 months in advance of the calendar year in which the storms will occur.

Armed with reasonable estimates of the number of dust storms for the season ahead, farmers could decide whether they need to take special protective measures. They could, for instance, maintain vegetative cover on the soil surface and establish crop barrier strips or ridges to reduce wind velocity at the soil surface. These measures would be in addition to those practices recommended every year in semiarid areas.

Weather records guide researchers

Analysis of weather records at Dodge City, Kans., and Garden City, Kans., indicates that generally more than 25 dust storms occurred during years noted for serious wind-erosion conditions. Serious damage can be prevented in these years only if farmers take special precautions.

The wind-erosion climatic index was developed by W. S. Chepil, F. H. Siddoway, and D. V. Armbrust, ARS soil scientists, in cooperation with the Kansas Agricultural Experiment Station. This index, expressed as a mathematical formula, shows the magnitude and relationship of precipitation, temperature, and wind velocity.

Conditions tend to occur together

Low precipitation, high temperature, and high wind velocity tend to occur together on the Great Plains. Temperatures and wind velocities usually are higher than normal in dry years and lower than normal in wet years. Sequences of several dry years and several wet years alternate in irregular cycles.

Within a dry cycle, wind erosion and dust storms become more serious each succeeding dry year, as vegetative cover decreases and surface soil becomes more pulverized. Thus, Chepil and associates compute the wind-erosion climatic index on the basis of weather conditions for 3 consecutive years.

The scientists explain that the erosion year in the index ends May 31 rather than December 31. This is because about 80 percent of all dust storms occur between January 1 and May 31. A dust storm prediction for 1964 thus would be made in June 1963, based on the average of conditions in three 12-month periods ending May 31 of 1961, 1962, and 1963.

Predictions are tested for accuracy

To test the accuracy of the index the researchers used weather records as a basis for "predicting" dust storm conditions during the years 1924–61 at Dodge City and 1936–61 at Garden City. They then compared their "predictions" with the conditions that actually prevailed in those periods.

They found that the index overestimated the number of dust storms 11 percent of the time and underestimated the number 5 percent of the time. However, the index seriously underestimated dust storm conditions only once in 64 predictions.

Overestimates would have no serious consequences, the scientists say, because the index predicts the number of dust storms that will occur if no preventive measures are taken. Its practical value is to warn farmers when to take precautions so that dust storms will not occur.

A substantial number of underestimates, on the other hand, would seriously impair the usefulness of the index, since farmers depending upon it would be inadequately warned in time to take protective measures.☆

Zero Tillage of Corn

Corn yields well in humid areas when planted in sod that was killed with herbicides

■ Zero tillage, or no tillage, may become a standard practice of some humid-area corn growers if results of preliminary research are borne out in further studies.

These terms describe an experimental system of planting corn on grass or grass-legume sod, with all usual plowing and cultivating eliminated. The sod, killed with herbicides prior to corn planting, remains as a protective mulch through the growing season.

Corn production without tillage is under study by ARS soil scientists, in cooperation with the Cornell University and Virginia Agricultural Experiment Stations. Their research indicates zero tillage has important soil conservation advantages. And corn yields (up to 140 bushels per acre in Virginia and 128 bushels in New York) on no-tillage plots were not significantly different from yields on conventionally prepared soil.

The scientists are not yet ready to recommend zero tillage. Although early studies indicate several advantages, there are problems not yet fully resolved.

ADVANTAGES:

1. Only two farming operations are required—application of early-season herbicide spray and planting.

2. Killed sod acts as a mulch during the growing season, restricting runoff and evaporation. In the Virginia experiments, available soil moisture to an 18-inch depth was greater with no tillage than with conventional tillage.

3. The mulch from the preceding grass crop reduces soil erosion.

PROBLEMS:

1. No completely satisfactory equipment is available for planting corn in sod.

2. Herbicides used for killing the sod may interfere with the establishment of oats or other crops following corn. In limited tests in Virginia, however, scientists were able to establish small grains, orchardgrass, and alfalfa after corn had been produced in sod killed by herbicides. Weeds that are resistant to the herbicide may also present special problems.

3. Plow-down applications of fertilizer are impossible with zero tillage. Fertilizer must be spread before corn is planted or added in the row at planting time.

4. Soil type and management of the preceding sod crop may limit the use of zero tillage. Soil compaction by grazing animals, for example, may be a problem. The practice has not been tested in extensive field trials.

In the Virginia experiments, tillage operations were completely eliminated. The corn was hand-planted,

LEFT—Orchardgrass sod, killed with herbicides, guards against erosion.

ABOVE—Grown without tillage, corn yielded as much grain as corn grown under normal cultivation.

in orchardgrass sod, in holes made with a small soil-sampling tube. The sod had been killed 5 weeks earlier by spraying with 4 pounds (active ingredient) of atrazine per acre. The plots were fertilized with 1,000 pounds of 10-10-10 per acre, broadcast after planting.

In the New York experiments, the corn was planted in narrow strips cut in the sod by a conventional corn planter the season following a good alfalfa-grass crop. The scientists killed the sod 4 to 6 weeks before planting the corn by spraying a mixture of 3 pounds of atrazine and 2 pounds of aminotriazole per acre. The plots were fertilized with 1,000 pounds of 10-10-10 per acre. Eighty percent of the fertilizer was applied as a topdressing before planting, and 20 percent was applied in bands with a conventional seeder at planting time.☆

MEASURING Potato Bruising

■ An inexpensive instrument, developed by USDA scientists to measure potato bruising, can help solve this number one problem in harvesting and handling potatoes.

This instrument is a guillotine-like device that has a yardstick and a falling weight as two of its main components. Scientists measure the susceptibility of a potato to bruising by examining it for bruises made by the falling weight and then relating the degree of injury to the height from which the weight was dropped.

Scientists hope to predict the amount of bruising that may be done (1) by a particular type of harvester to a crop of potatoes or (2) by a particular storage method. Agricultural engineers will use the instrument in designing and improving machinery to reduce bruising during harvest; marketing researchers will use it in work on storage and handling; and plant breeders can use it to test new potato varieties for bruising susceptibility.

The instrument was developed by G. W. French, ARS agricultural engineer, and H. Findlen, Agricultural Marketing Service horticulturist, at the Red River Valley Potato Research Center, East Grand Forks, Minn.

To test for bruising, a weight is dropped from the desired height onto a potato. The weight, guided by two metal rods, is similar to a digger rod of a harvester.

Growers may find tool useful

Although the instrument was developed primarily as a research tool, potato growers may find it useful. For example, before employing harvesting crews and equipment, a grower might dig a few potatoes by hand and check them for bruising susceptibility. He then could decide whether to harvest immediately or wait a few days. Under most conditions, the longer potatoes remain in the ground the less susceptible they become to bruising. Skins toughen as potatoes mature.

French and Findlen are developing a numerical index that will be used as a guide in measuring susceptibility of a potato to bruising. A given index may indicate that if the potatoes are harvested immediately, the grower can expect 10-percent injury. A few days later, the index may show that only 2 or 3 percent of the potatoes will be bruised during harvesting.☆

NEW SEED OILS FOR INDUSTRY

Foreign species of plants are being studied for sources of oil, fibers, gums, and protein seed meals

■ Several promising oilseeds and fiber plants have been found in a broad research effort by USDA to develop new crops for industrial markets.

Intensive study is being given to crambe, parsley, cape marigold, indian ironweed, meadowfoam, kenaf, and plants related to them.

These plants have been selected from more than 2,000 species evaluated as potential new crops by ARS utilization chemists and crop scientists.

New crops that may result from these studies are expected to provide farmers with additional sources of income without competing for industrial markets now supplied by domestic crops. Some of these crops may serve as domestic sources of strategic or critical materials or provide larger supplies of such materials; some may give rise to new industries, important in Rural Areas Development.

In addition to examining the new crops for pulp fibers and oils, the researchers are evaluating them for other components. These include protein seed meals suitable as livestock feed and water-soluble gums needed in paper making, oil-well drilling, and some foods. The economic value of any new oilseed crop would be greatly enhanced if it also yields a nutritious, high-protein meal for animal feed.

Preliminary development work on these new plants is the responsibility of the four ARS Utilization Research and Development Divisions, located at Peoria, Ill., Philadelphia, Pa., Albany, Calif., and New Orleans, La., and the Crops Research Division, headquartered at the Agricultural Research Center, Beltsville, Md. The chemical evaluation is being done by a team of chemists headed by I. A. Wolff at Peoria; the agronomic evaluation by a team of botanists headed by Q. Jones at Beltsville.

Here are some highlights of their findings:

MUSTARD—Seed oils of many mustard family plants, including rape, oriental mustard, and crambe (*Crambe abyssinica*), contain erucic acid. Oil containing this acid is now imported for use primarily in rubber manufacture (AGR. RES., November 1962, p. 6).

Wild members of the mustard family, the lesquerellas, are a source of two new fatty acids. Lesquerolic and densipolic acids, found in *Lesquerella lasiocarpa* and *L. densipila*, have industrial potential. Lesquerella oils bear some similarity to castor oils, but they are expected to have uses of their own in coatings, plastics, and chemical intermediates.

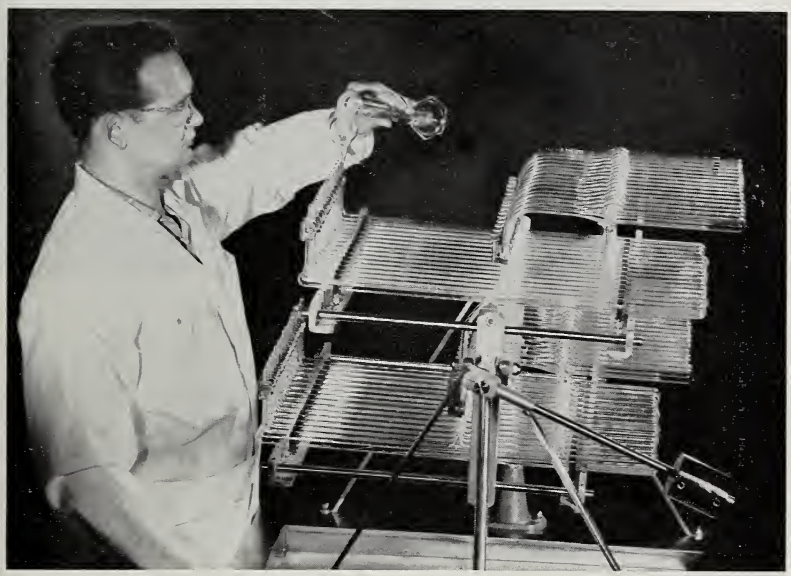
PARSLEY—Seed oils that yield petroselinic acid, named for the genus *Petroselinum*, are being studied as sources of chemicals for making such products as plastics, synthetic rubbers, lubricating-oil additives, and protective coatings. The chemists say there are established markets for several hundred million pounds a year of petroselinic acid derivatives such as adipic and lauric acids.

Parsley family plants that have been evaluated include carrot, parsnip, and blue laceflower.

CAPE MARIGOLD—Another new fatty acid, dimorphecolic, was found in seed of the species *Dimorphotheca sinuata*. Dimorphotheca oil has been used in experimental coatings and rigid foams. Chemists say the foams are strong and lightweight and have heat-insulating properties. Studies of the drying properties of raw, dehy-

LEFT—Various oils are extracted by passing a solvent through ground seed that is held in filter paper.

RIGHT—Seed-meal proteins are analyzed for kinds and amount of amino acids; the data are recorded automatically.



LEFT—Various components of seed oils are separated out for study.

drated, and heat-bodied dimorphotheca oil show it has good technological potential in the coatings field.

INDIAN IRONWEED—Seed oil from indian ironweed, *Vernonia anthelmintica*, yields more than 70 percent epoxy fatty acids. Now made synthetically, these acids are used in plastics, paints, and many new products.

ARS chemists are evaluating vernonia oil in plastics, to which the epoxy acids add flexibility and protection from sunlight and heat. In tests as stabilizers for plasticized polyvinyl chloride, vernonia oil and derivatives of it proved equal to or better than commercial plasticizers.

ARS agronomists have grown ironweed in Nebraska, North Carolina, and Texas, in cooperation with the State agricultural experiment stations. These test plantings show the plant is widely adapted to parts of the corn and cotton belts.

MEADOWFOAM—Seed oil of meadowfoam, *Limnanthes douglasii*, was found to be a source of three new fatty acids. Meadowfoam, a native of the Pacific Coast States, is grown now as an ornamental.

More than 95 percent of all fatty acids from limnanthes oil, including the three new ones, have longer carbon chains than those from vegetable oils now commercially available. Some derivatives of the oil are waxy solids similar to waxes used in polishes, phonograph records, pharmaceuticals, and cosmetics.

KENAF—This species and the related *Hibiscus*, which includes okra, are being studied as crop sources of fiber from which paper can be made. ARS research shows kenaf stems can be used alone or with presently used wood fibers in making paper pulps by conventional processes.☆

Updated approach to historic trade aids small communities

Maple Sirup Making, 1963

Plastic tubing conveys maple sap from trees (right) to a centrally located tank, thus eliminating individual buckets.

Tank truck picks up sap from several producers and delivers it to a modern central evaporating plant.

■ A few years ago ARS research on maple sirup gave a producer in central New York State an idea for expanding his business. This idea has set a new pattern for the maple-sirup industry that might well become an important part of Rural Areas Development.

In need of additional sap, the New York sirup producer looked to the vast stands of maple trees standing idle within a 15- to 20-mile radius. He knew the farmers who owned these trees needed cash but lacked the equipment and skill to make sirup. So he offered to buy their sap if they would tap their trees and make delivery to his evaporator.

Sap had never before been a marketable commodity. Because tree-tapping was not profitable except as part of an integrated maple-sirup operation, the idle trees in New York were typical of U.S. maple forests. Sap is collected today from only about 5 percent of the tappable maple trees.

Farmers are selling sap at a tidy profit

At first skeptical, these New York farmers are now selling their sap at a tidy profit, and the sirup producer has a long waiting list of prospective sap suppliers. This successful venture, the first central evaporator plant, became a reality because of the technical advice and assistance given by ARS chemist C. O. Willits of the Eastern utilization research laboratory, near Philadelphia. Willits has directed ARS research on maple sirup for many years.

The modern central evaporator plant in New York represents an investment of about $20,000. The business supports two families, the owner's and his father's, and it provides part-time jobs for others in the community. The plant is in operation throughout the year, making not only sirup but also confections and other maple products.

Suppliers are paid up to $1.90 per taphole

Suppliers of sap are presently paid 75 cents to $1.90 per sap taphole for a season's production, depending on the quality and amount of sap produced. Since the average stand of maple trees has up to 160 tapholes per acre, these farmers gross $100 or more per acre from their trees.

Central evaporator plants modeled after the New York plant have been established in Vermont, Michigan, Wisconsin, Pennsylvania, and Ohio, as well as elsewhere in New York. These central plants offer substantial opportunities for employment in the vast northeast maple area, which extends as far west as Minnesota and as far south as Kentucky and West Virginia.

Maple-sirup specialists say it is paradoxical that we have not exploited the profit potential of U.S. maple trees more widely, since maple sirup is one of the few American farm commodities for which the demand exceeds the domestic supply. Only about half the sirup used in the

U.S. is produced here; the rest is imported from Canada.

Production in the U.S., they feel, should be stimulated by this new concept of central evaporation, which makes it easier for farmers to realize a profit from their maple trees. Central evaporator plants, in turn, are in an excellent position to take full advantage of ARS maple-sirup research, which has virtually revolutionized the entire maple industry.

The collection of sap with plastic tubing instead of the old sap buckets is one of the important changes that this research has helped make possible. Several networks of tubing can be laid out in a given maple "bush" to carry the sap by gravity directly to storage or collection tanks located near roads. Tubing eliminates practically all the hand labor otherwise required for sap collection (40 percent of the labor costs of sirup production). It also avoids the necessity of expensive maintenance of roadways and equipment to haul the sap through the bush.

Research has, in addition, established the importance of protecting sap and sirup from micro-organisms to preserve quality. Plastic tubing does this by providing a clean, closed system for sap collection. For further protection, germicidal pellets can be placed within the taphole. These pellets, also developed in ARS research, were first used commercially last year, when they increased sap yields by a third to a half by preventing premature drying of tapholes. They also contributed to the production of top-quality sirup.☆

Potato Breeding Lines Resist Golden Nematode

■ Two experimental breeding lines of potatoes with resistance to the golden nematode and several major diseases have been developed by ARS plant breeders. These experimental lines (seedling varieties) have not yet been named or designated as varieties; they are identified only by numbers.

The golden nematode, found on New York's Long Island in 1941, is recognized as one of the most difficult of all crop pests to control. It has been a constant threat to the potato industry on Long Island, where it has been confined by rigid quarantine measures.

In addition to resistance to golden nematode, one of the new lines possesses resistance to late blight and scab, and the other is resistant to rugose and mild mosaic. Tests to determine shipping and cooking qualities and to learn more about yield potential must be completed before the new potatoes can be released to growers.

In varieties susceptible to the golden nematode, second-stage larvae of the nematode enter the potato roots, where they feed while passing through two more development stages to the adult stage. The adult females then produce eggs. But in resistant varieties, for a reason not yet clearly understood, the nematodes feeding within the roots fail to reach the mature egg-producing stage.

If enough nematodes are present in the soil, larvae feeding on the roots of resistant varieties may cause wilting and reduced yields the first year the potatoes are planted. But since the larvae that enter the roots fail to reproduce, the nematode population decreases in the soil. Because of this reduction, damage to potatoes should decrease after the first year, though it is doubtful that nematodes will be eliminated in this way under field conditions.

Studies in which potato breeding material was evaluated for nematode resistance were conducted in cooperative research by ARS and the Cornell University Agricultural Experiment Station.

In similar breeding programs in Europe, scientists have encountered a race of the golden nematode that breaks through the newly found plant resistance. If a similar race develops here, it will be necessary to breed potatoes with additional resistance. R. V. Akeley, leader of potato investigations for ARS, says that genes are present in available potato breeding stocks for use in building up this resistance.☆

Why Multiple Embryos?

A single egg from an unmated hen may contain as many as eight developing embryos

■ ARS studies of turkey parthenogenesis (development of embryos or poults from unfertilized eggs) reveal a sharply higher incidence of multiple-embryo development in unfertilized eggs than in eggs from mated hens.

A single egg from an unmated hen may contain as many as eight developing embryos after several days of incubation.

This research, underway at the Agricultural Research Center, Beltsville, Md., is part of a long-range basic study of fertility and hatchability in chickens and turkeys. The multiple-embryo finding is not expected to be of practical significance, but it may help researchers understand more about turkey reproduction, which is highly important to breeders and hatcherymen.

The incidence of multiple-embryo formation in eggs from unmated turkey hens was about 14 percent, compared with less than 0.1 percent in eggs from mated hens. None of the multiple embryos hatched; most of them died after only a few days of incubation.

Selection lessens multiple embryos

The unmated hens had not been selected for a high incidence of parthenogenetic development. Turkeys in which this trait had been built up through breeding produced eggs showing a relatively low incidence (4 percent) of multiple-embryo formation. (All the living fatherless turkeys at Beltsville are offspring of these specially bred turkeys.)

M. W. Olsen, poultry physiologist, who heads the studies on parthenogenesis, suggests several possible explanations for these wide disparities. A normally developing embryo in an egg from a mated hen may exert an early dominance over all regions of the germinal disc ("germ spot" on the yolk). Thus, the occurrence of mul-

Multiple embryos developed in 14 percent of the eggs from unmated turkey hens, compared with less than 0.1 percent of the eggs from mated hens. Drawing (enlarged) shows embryo at same stage as twin embryos in the photograph.

tiple embryos is suppressed in fertilized eggs.

Embryonic development may begin in several areas of the germinal disc when an unfertilized egg is incubated. No single area is more prone to cell growth than any other.

No poults have been known to hatch from eggs of unmated *unselected* turkey hens. But by selecting and breeding turkeys that tend to produce eggs in which early parthenogenetic development takes place, Olsen has obtained live poults from eggs of highly inbred virgin hens. Apparently this selection for high incidence of parthenogenesis has also increased the incidence of single instead of multiple embryos.

Earlier studies showed that parthenogenetic embryos develop more slowly than normal embryos do. This suggests an intriguing possibility to Olsen:

A normal embryo starts developing when the egg is fertilized. *By the time a fertile egg is laid, its germinal disc is an organized, growing mass of cells. In the case of an unfertilized egg, however, it may be that single or multiple embryos develop from individual cells on the germinal disc after the egg has been laid and is being incubated.*

Olsen says that live viruses may initiate this development. More multiple-embryo eggs were laid by unmated hens shortly after vaccination with a live virus than were laid by hens vaccinated 6 to 8 months earlier. Vaccination with a killed virus, however, failed to increase the incidence of multiple-embryo development.

To test this idea further, Olsen plans to inject live virus into newly laid fertilized eggs, then incubate them several days. He wants to find out if the virus will trigger the development of parthenogenetic embryos in eggs already containing naturally conceived embryos.☆

By August, strawberries set out in April (middle row) and May (right) had dense growth of runners. Excess-runner removal was not a problem in June-set plants (left). At season's end, density was the same.

Delayed Strawberry Planting

■ June is generally considered 2 to 3 months too late for East coast strawberry growers to set out plants.

But USDA tests at Beltsville, Md., using cold-stored plants, demonstrate that June may be an ideal planting time.

Research workers found no essential differences in yield, fruit size, amount of fruit decay, or crown size of strawberries planted in April, May, or June. Growers normally plant no later than April.

In the tests, less labor was needed to control weeds and remove excess runner plants in June-set plots than in plots set in April or May.

June planting studies have not been conducted in other East coast areas, but the scientists say response south of the Mason-Dixon line should be similar to plant response at Beltsville. They advise interested growers to try small plantings to determine best planting dates.

June setting is made possible by a handling and storing method in which dormant plants are dug in winter months, bundled in crates lined with polyethylene, and stored at 30° F. This method was developed in previous research by J. T. Worthington, Agricultural Marketing Service horticulturist, and D. H. Scott, ARS horticulturist.

Plants handled this way retain their succulent, bright-green foliage and vigorous roots for as long as 10 months in cold storage. Cold-stored plants are available from many East coast nurserymen.

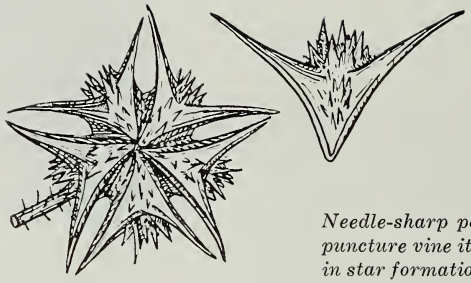
Before a method was developed for storing plants in good condition over a period of many months, early setting—in March or April—was recommended. Most East coast growers still plant early, even if they use cold-stored, polyethylene-packaged plants. In the date-of-setting tests, Worthington and Scott used plants of four varieties—Surecrop, Pocahontas, Sparkle, and Blakemore. Matted strawberry beds were kept a uniform 2 feet wide by periodic removal of excess runners.

On April-set plots, excess runners were removed four times between August and October. On May-set plots, runners were clipped three times between September and October. On June-set plots, a few runners were removed once, in October. By the end of the growing season, plant density was the same on all plots, regardless of when they were planted.

Irrigation was necessary to give a good start to plants set in June. But the need for irrigation is not necessarily limited to June planting. In many cases, the researchers point out, irrigation is desirable throughout the growing season, regardless of planting time.☆

Beneficial Weevils . . .

They feed on puncture vine



Needle-sharp pods, which give puncture vine its name, cluster in star formation until mature. Pods injure workers, cut tires.

■ Control of the puncture vine weed is being aided in western and southwestern parts of the United States through the introduction of two foreign weevils that kill the weed by feeding on it.

One of the weevils, *Microlarinus lareynii*, feeds solely on puncture vine seed; the other, *M. lyrpiformis*, feeds only on the stems. Both species were fully tested by ARS scientists in Europe before being introduced into the U.S., to make sure they do not attack crop plants.

The puncture vine, a native of the Mediterranean countries, is a spreading plant that produces very hard, sharp pods. These pods can injure the feet or knees of field workers, who often refuse to work in infested fields. The pods also cause damage to the feet of grazing and work animals and the tires of farm vehicles.

Workers of the California Agricultural Experiment Station and other public and private organizations pioneered in early efforts to control the vine by means other than beneficial insects. In 1957 California officials requested that ARS investigate the possibility of biological control of the vine.

When the two weevils were imported in 1961, substantial numbers were released in California, Nevada, Washington, Arizona, Utah, and Colorado. The weevils survived winter hibernation, and both species were found in the summer of 1962 in most of the release areas.

Later in the summer, population explosions of these beneficial insects—especially the seed weevils—were noted in several areas. This successful colonization has since prompted Texas, New Mexico, and Hawaii to introduce the weevils in areas infested with puncture vine.☆

Ovarian Hormones . . .

Their influence on infection

■ ARS animal physiologists have found that sex hormones—which regulate the reproductive cycle in sheep and other animals—have an adverse effect on the speed and efficiency with which ewes react against infection of the uterus. These findings contribute to a better understanding of the action of female hormones and how animal cells respond to infection.

When infectious organisms were placed in the uteri of nonlactating ewes at Beltsville, Md., the ewes whose blood contained high levels of the ovarian hormone estrogen reacted faster than ewes influenced by another ovarian hormone, progestin. Estrogen levels are usually highest a few days before and during heat, and progestin levels are normally highest between the fifth to the eleventh day after heat. Ewes whose ovaries had been surgically removed—and therefore weren't influenced by ovarian hormones—reacted fastest to infection.

Speed and efficiency of reaction were gaged by the number of white blood cells in the uteri of animals killed 2, 4, 8, or 16 hours after being infected. White blood cells (leukocytes) engulf and destroy bacteria and other infectious organisms.

The researchers say progestin delayed the white blood cell activity longer than estrogen. They explain that these hormones inhibited the migration of white blood cells from blood vessels into the uterus during the early stages of the induced infections. So the numbers of responding white blood cells indicated the extent to which hormones interfered with the reaction against infection.

Ovarian hormones apparently don't have much effect on the animal's reaction to infection in other parts of her body. The scientists have learned, for example, that estrogen and progestin have only a slight effect on the reaction to infection in the mammary glands. Ewes reacted similarly whether in heat or not. Inflammation of udder tissues started almost immediately after infection. Slightly less inflammation took place in udders of ewes without ovaries.

These studies, by T. H. Brinsfield, H. F. Righter, and H. W. Hawk, are continuing at USDA's Agricultural Research Center.

AGRISEARCH NOTES

Lucas gets Newman poultry award

Dr. Alfred M. Lucas is winner of the 1962 Tom Newman Memorial International Award. His book, *Atlas of Avian Hematology*, brought him the honor last month from the Poultry Association of Great Britain.

Dr. Lucas did the reasearch for his book at the ARS Poultry Research Laboratory in East Lansing, Mich., where he is a cytopathologist (authority on diseases of animal cells).

The *Atlas of Avian Hematology* is the first reference book ever published on identification of blood cells in chickens. It is of utmost value to poultrymen, veterinarians, and research workers in zoology, embryology, physiology, and nutrition in their efforts to control poultry diseases.

Studies of blood diseases of poultry were more difficult before the publication of this book because a reference work on the structure of normal and abnormal cells did not exist. The *Atlas*, published in 1961, gives detailed descriptions of healthy and diseased cells and is illustrated in color by medical illustrator Casimir Jamroz.

The Tom Newman Memorial International Award is made each year to the author of the most important work on poultry husbandry published in any country the year before.

Seedling emergence force is rated

Scientists can now measure the force a seedling shoot exerts when it penetrates crusted soil. Their method provides a tool to assist researchers in future studies of seedling emergence.

Wax was used to simulate crusted soil in laboratory experiments conducted by ARS soil scientist H. M. Taylor, in cooperation with the Texas Agricultural Experiment Station. He used a standard testing technique to determine the wax-penetration number—the depth (in tenths of millimeters) a needle with a standardized point will penetrate in 5 seconds under an applied load of 100 grams.

Taylor used wax crusts of known penetration numbers for sealing quart cans in which he had planted wheat, grain sorghum, and guar seeds. The cans then were kept under controlled light and temperature until all the seeds germinated. The number of seedlings that emerged through the

wax crusts was the basis for determining the relation of crust resistance to seedling emergence.

No seedlings pierced was crusts having a penetration number of 27 or less. A few of each kind of seed emerged through crusts with a penetration number of 28.5. As the hardness of the crust decreased (indicated by a larger penetration number), a greater proportion of the seedlings emerged. At penetration numbers of 60 to 70, a majority of the seedlings came through the crusts.

These experiments shed light on one of the four ways in which seedlings create a pathway through crusted soil—that of exerting sufficient pressure to force an opening. Other ways are (1) breaking and lifting the crust by the combined force of several plants, (2) emerging through cracks, and (3) transferring water from roots to shoot tips to soften the crust.

Conserving irrigation water

Farmers can conserve irrigation water in sorghum fields by applying only enough water to soak the soil to a depth of 3 feet, ARS-Arizona experiments show.

In studies of sorghum root growth in Laveen loam soil, scientists found that 90 percent of the roots are confined to an area 3 feet deep and extending 15 inches laterally from the plant. They also found that 90 percent of the moisture used by the sorghum plants comes from this root zone.

Radioactive phosphorus was used by ARS chemist F. S. Nakayama and physicist C. H. M. van Bavel to trace these root-growth and moisture-extraction patterns of irrigated sorghum. They worked in cooperation with the Arizona Agricultural Experiment Station.

The radioactive phosphorus was injected to soil depths of 6, 12, 18, 24, 36, and 48 inches at lateral distances

of 5, 10, 15, and 20 inches from the plant rows. Leaf samples were taken periodically from a given plant through the growing season and analyzed for the radioactive phosphorus content. Then, to chart the extent of root growth, the scientists correlated the amounts of phosphorus taken up by the leaves with the distances from the plant to the injection points.

The soil moisture was measured with a neutron probe and portable rate meter (AGR. RES., November 1961, p. 12).

UNITED STATES GOVERNMENT PRINTING OFFICE
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OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID PAYMENT OF POSTAGE, $300 (GPO)

New instant powdered vegetables

Dry beans, peas, and lentils may soon take their place with other "instant" convenience foods, as a result of a dehydration process developed by ARS food scientist H. J. Morris.

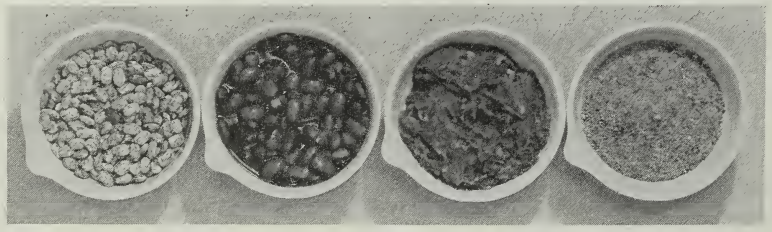
Powders made of these dry vegetables reconstitute instantly in water or other liquid to make products with all the flavor and nutritional value of the original dried foods.

Commercial development of the process would offer consumers the convenience of "instant" appetizing dips, croquettes, casseroles, chili, soups, and vegetable and meat stuffings. Vegetable or meat flavors can be "built" into the powders, or flavors can be added when the powders are used in various preparations. This new product could, in addition, prove useful to managers of large food services and the military.

Morris' process has, in effect, moved the job of preparing purees of these dried foods out of the home and into the processing plant. Developed at the ARS Western utilization research laboratory, Albany, Calif., the initial steps of the process include briefly scalding the dried legume, overnight soaking, and cooking in the soak water.

The cooked product is then made into a puree with equipment that forces the material through small perforations in a metal plate. The puree is spread in a thin film on a rotating heated drum, where it dries for less than a minute before it is scraped off. In powder form, at about 5 percent moisture, it is put in cans in which air has been replaced by nitrogen.

All varieties of legumes tested thus far have proved suitable for manufacture into "instant" dry products.



Processing stages in making the instant products are (left to right) dry beans, cooked beans, puree, and instant flakes.

Turkeys like abrupt light change

An abrupt lengthening of the winter day with artificial lights is slightly more effective in improving reproductive ability of turkeys than a gradual lengthening of the day, ARS researchers say.

Their findings confirm the benefits of abrupt lighting practices followed by many turkey breeders. Artificial lights are used to make birds start laying earlier in the year and produce more hatching eggs.

In testing one method against the other, the scientists tried gradual increases in day length on three groups of Beltsville Small White breeding turkeys and abrupt increases on three other groups. All birds were exposed only to incandescent white light in a windowless and roostless building, equipped with force-ventilated air conditioning.

Turkeys subjected to the abrupt change in day length began laying about 5 days earlier and averaged nearly 3 more eggs and 6 more poults (because of increased fertility) for the 11-week test period.

The research was conducted by poultry husbandmen S. J. Marsden and N. S. Cowen and agricultural engineer L. M. Lucas at the Agricultural Research Center, Beltsville, Md.

Initially, all the breeding turkeys got 9½ hours of artificial light per day, which corresponds to the length of a day in late December at Beltsville, Md. Day length was then increased gradually or abruptly to 11, 13, or 15 hours, by turning on lights earlier in the morning. The lights were turned out at sunset.

For the three groups that underwent the gradual increase in day length, light was turned on 30 minutes earlier each morning until the desired day length was attained. For the groups undergoing the abrupt change, the lights were turned on 1½, 3½, or 5½ hours earlier.

Whether the light was added abruptly or gradually, the turkeys performed best on the 13-hour day.

U.S. GOVERNMENT PRINTING OFFICE: 1962